

Listeria and Whole Genome Sequencing

Whole genome sequencing improves the detection and investigation of foodborne outbreaks

Whole genome sequencing is an important tool for disease detectives. It provides genetic information about germs that are making people sick. This information improves our ability to detect, investigate, and stop foodborne outbreaks.

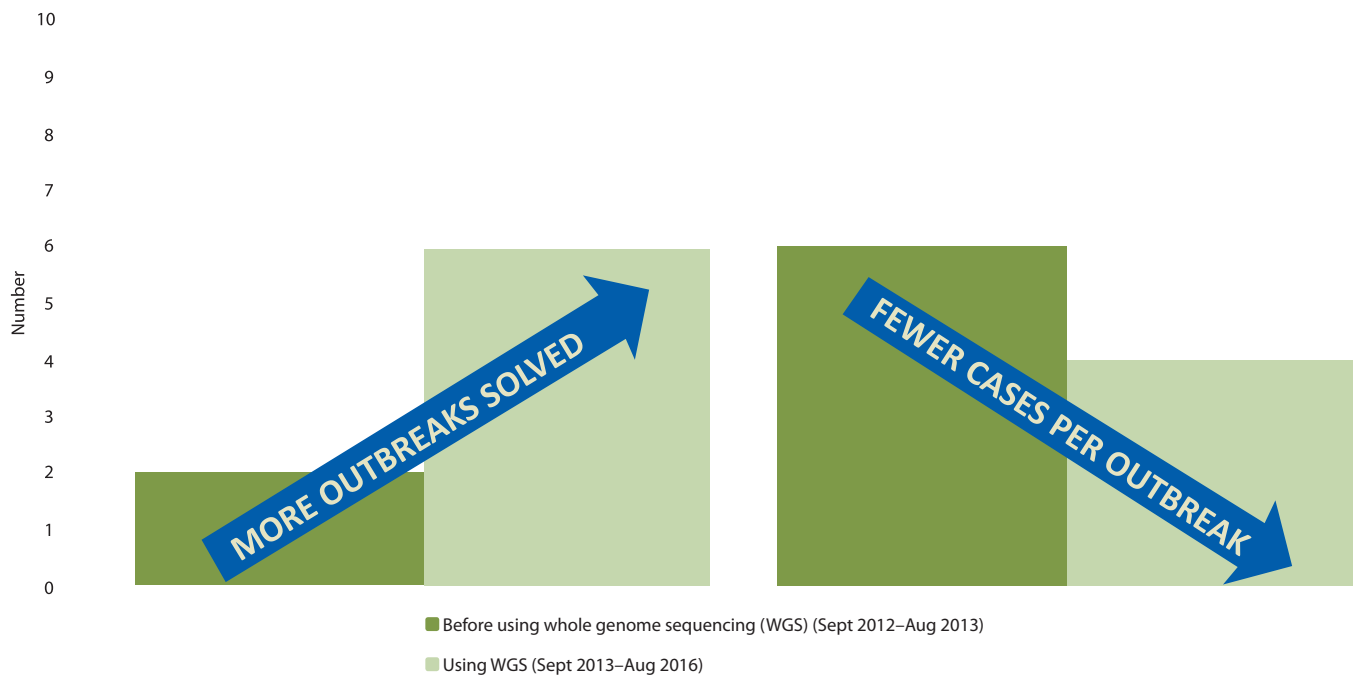
Whole genome sequencing is a process that uses laboratory methods to determine the complete DNA sequence of an organism's genome.

With whole genome sequencing, *Listeria* outbreaks can be detected when as few as two people have gotten sick. Determining that the same strain of *Listeria* is making people sick is an indication that these illnesses may have come from the same source – for example, the same contaminated food or the same contaminated food processing facility. Thus, whole genome sequencing can help disease detectives solve outbreaks.

By combining real-time whole genome sequencing with data from patients about the foods they ate and data about *Listeria* in foods, public health officials can:

- Detect more clusters (possible outbreaks) of *Listeria* infections
- Link cases of *Listeria* to a likely source
- Identify unrecognized sources of *Listeria*
- Stop *Listeria* outbreaks while they are still small

Whole genome sequencing prevents *Listeria* illness



National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne, Waterborne, and Environmental Diseases



Moving into the future

Whole genome sequencing alone cannot solve outbreaks, but it has dramatically improved our ability to track *Listeria* and other germs. Epidemiologic data, such as information about what foods people with *Listeria* ate before they got sick, are critical for outbreak investigations. Solving outbreaks caused by *Listeria* and other germs will improve with continued efforts to obtain important epidemiologic information, and to strengthen the link between epidemiologic and whole genome sequencing data.



Federal agencies collaborate to prevent *Listeria* infections

Whole genome sequencing of *Listeria* began as a one-year project in fall 2013 as a collaboration between the Centers for Disease Control and Prevention, U.S. Food and Drug Administration, U.S. Department of Agriculture, National Center for Biotechnology Information, and state and local health departments. The practices developed during this project have now become standard.

Successful investigations depend on drawing data from these laboratory and epidemiological sources:

PulseNet, a national laboratory network that collects information about *Listeria* and other germs isolated from patients

PulseNet uses pulsed-field gel electrophoresis (PFGE) and whole genome sequencing, two types of DNA fingerprinting. Scientists characterize *Listeria* isolated from a sample of the patient's blood or other tissue. The DNA fingerprint from a patient's *Listeria* is compared with hundreds of *Listeria* DNA fingerprints from other patients. When PulseNet identifies a cluster of people with related *Listeria* germs, it notifies epidemiologists, who begin an investigation to look for a common source of the illnesses and check GenomeTrakr to see if there are matches to food isolates. PulseNet is a collaboration among CDC, FDA, USDA, and state and local health departments.

The *Listeria* Initiative, a national epidemiology system that collects reports of *Listeria* infections in humans

As quickly as possible after *Listeria* infection is diagnosed, health officials interview the ill patient using a standard questionnaire about foods recently consumed. The *Listeria* Initiative is a collaboration among CDC and state and local health departments.

GenomeTrakr, a national laboratory network that collects information about *Listeria* and other germs isolated from food and the production environment

When a *Listeria* isolate from food or the environment is sequenced, GenomeTrakr checks the PulseNet database to identify possible links to *Listeria* DNA fingerprints from patients. GenomeTrakr is a collaboration among FDA and public health and university laboratories.

Recent [Listeria outbreaks](#) were linked to these foods:

